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(54) Title: DENTAL BRIDGE ASSEMBLY AND BINDING AGENTS THEREFOR

(57) Abstract: In the formation of dental bridges, the preferred material is a tightly-sintered aluminium oxide, and it is normal practice that the necessary bridge parts, namely two bridge anchors and a connecting intermediate link (pontic), are formed by a specialist and thereafter joined together in a dental laboratory where use is made of a melted glass as binding agent, after which the assembled bridge item is fired with porcelain. With the invention it has been found that considerable advantages can be achieved when a dispersion of said aluminium oxide or a material related herewith is used as binding agent, which after application between the assembly surfaces is heated until loose sintering is achieved, after which an infiltration of the sintered material by the glass is brought about by renewed or additional heating. There is hereby achieved a more simple working process as well as a stronger binding both between the assembly surfaces as well as between the bridge item and the porcelain with which it is fired. The binding agent is preferable mixed with an adhesive material which eases the intermediate work with the bridge item, and which is completely degassed by the heating in the said sintering process.

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Dental bridge assembly and binding agents therefor.

The present invention relates to the manufacture of dental bridges of aluminium oxide, which is currently one of the preferred materials for this purpose. A practice has been developed by which the dentist prepares the two supporting teeth (implants) as anchors for the intended bridge, and thereafter takes an impression of the relevant area by using a decidedly form-stable impression material, in that the impression shall subsequently be used for the manufacture of both a master model and a fireproof model.

The impression is transferred to a dental laboratory where a mould is made for the manufacture of a master model in hard plaster. A duplicate mould of the master model is made for later manufacture of an individual fireproof support model, a so-called "firing table".

Hereafter, the bridge is modelled up in a three-part formation comprising the two bridge anchors and a connecting intermediate link (pontic), of which the latter can, however, be prefabricated, with certain directions concerning dimensions for the transition areas between the three sections. Thereafter, these transition areas are cut over with a plane cut in accordance with a more detailed direction regarding the angle, and the three parts are sent to a specialist for the manufacture of the bridge parts in tightly-sintered aluminium oxide. However, in modern practice it is a preferred alternative that a three-dimensional scanning be carried out of the mould of the bridge parts, whereby one can suffice with a quick electronic transmission of the relevant scanning data to said specialist, who subsequently reproduces the parts in aluminium oxide.

The dental laboratory will then receive the three bridge parts which, after a possible grinding-off of excess material, are temporarily joined together, e.g. with cyanillite

glue, after which a fireproof "pilot model" of the bridge is made. The already-mentioned individual "firing table" is also made for use as support element in the subsequent firing of porcelain on the assembled bridge. The fireproof material is  
5 allowed to set, after which both models are placed in a special kiln for degassing, which must be programmed in accordance with the directions for the selected fireproof material.

With the known technique, use is made of glass powder as  
10 a binding agent, which in aqueous suspension is formed as a ball which is placed on top of the relevant assembly areas, after which the glass is activated by suitable heating in an ordinary porcelain kiln, in that the glass is hereby sucked down between the assembly areas.

15 The thus assembled bridge frame is removed for final processing. During the subsequent, ordinary porcelain firing, the item must be supported on the said, pre-prepared "firing table", in that the glass binding in the assembly areas becomes unstable at the firing temperature.

20 It has been ascertained that although it is used to a wide extent, this method is not particularly ideal, in that it is very work-demanding and results in products which have a breaking strength which is not satisfactory. Many attempts have been made to improve it, but hitherto without significant results. Primarily, the solution will be to find an improved binding agent, but although highly-developed binding  
25 agents and great expertise already exist in the dental field, the result has always been that the "molten glass" has hitherto remained the agent which is used.

30 With the invention it has been found that a perfect binding agent consists of a material related to the bridge material and an already-known moulding material, namely in the form of loosely-sintered aluminium oxide or a corresponding sinterable material with glass infiltration. In its finished

form, this material can bear comparison with the above-mentioned tightly-sintered aluminium oxide, but it is suitable for producing in the laboratory as the material does not need to be compressed. It can be shaped in suspended form and thereafter vitrified, after which a dispersion of glass powder is applied to the resulting sinter body, the glass powder being melted by a renewed or increased heating for infiltration of the glass in the loosely-sintered binding agent.

With the invention, no independent body is formed in the relevant second material, in that the material is formed laboratory-wise only as a binding agent between the main parts of the bridge frame and the tightly-sintered material. This gives rise to two important conditions, firstly that the product appears with a distinct and quite surprising increased breaking strength, and secondly that in the manufacturing process, such a good form stability of the assembled bridge frame is achieved that this, by the incorporating of a flammable adhesive in the binding agent, is suitably firm for handling for transfer to a sintering furnace and becomes fully heat-resistant after the said sintering, so that thereafter the item can freely be further processed and re-heated respectively for glass infiltration of the binding agent and final firing of porcelain, without the production and use of the said "firing table" being necessary.

Aluminium oxide with an adhesive for formation of an initial binding between the bridge parts can be applied with a brush to the assembly surfaces as a watery paste, respectively by modelling-in between the assembly surfaces. After a quite short drying period, there will be achieved such an initial binding that the assembled item can be transferred without any special form stabilisation to an ordinary firing kiln which does not require vacuum connection, and in which a sintering of the binding material is effected, for example for two hours at approx. 1140° with a rise of  $\frac{1}{2}$  an hour.

Hereafter, the assembled bridge frame is thoroughly stable for handling, and it can be removed for possible grinding as required and subsequent application of an aqueous glass-powder mass around the assembly areas.

5        Thereafter, the actual glass infiltration can be effected, e.g. in the already mentioned ordinary firing kiln, in that here it is sufficient to place the item on fire cotton or in another loosely supported or suspended manner. A firing at approx. 1140° for two hours with a rise of ½ an  
10 hour can be typical, but the main thing is that the firing is concluded when the loosely-sintered aluminium oxide has absorbed that amount of glass it can accommodate.

The glass infiltration can well be carried out in the utilised simple firing kiln in direct extension of the sintering, in that the glass mass can be placed on the bridge  
15 item in local accumulations at the assembly areas in such a manner that these accumulations will remain firm at the sintering temperature, and are first brought to melt at an increased temperature of around 1200° when the sintering has  
20 been completed. The glass material will hereby not have any blocking effect against emission of the gases which are released by the sintering, and the glass infiltration can be brought about solely by a further heating of the kiln in one and the same firing sequence. Thereafter, the bridge will be  
25 totally stable for handling.

It shall be noted that the expression "glass infiltration" is a trade expression which, while although referring to the material "glass", is not however limited entirely to this material (felspar), in that it can also embrace other  
30 materials with high melting point and corresponding infiltration and reinforcement characteristics.

After this processing, the bridge frame can be removed for sandblasting of a possible distinct surplus of glass, and thereafter a "glass control firing" can be effected, e.g. at

970° for 10 minutes for the release of a possible surplus of glass, which can thus also be removed. Thereafter, the bridge frame can be given a final polishing.

The bridge frame will thus be ready for a quite conventional application and firing with porcelain, and whereby it will not be necessary to make use of any individual "firing table", as the bridge frame will already be completely form-stable during exposure to the associated temperatures.

The finished bridge appears with an increased and in practice a fully acceptable breaking strength with regard to pressure and torsional influences, and it will be produced by a considerably simplified process.

The invention has certain additional advantages on more specific planes, such as with a modelling-up or out of the binding material on the assembly surfaces, in the event of an under-dimensioning of these, an extended assembly surface can be achieved which not only reinforces the assembly in itself, but also provides an improved adhesion to the outer porcelain. It applies for the binding agent or the product according to the invention that this will adhere better than pure glass both to tightly-sintered metal oxides and porcelain.

The invention will embrace both the described method, the described "two-stage binding agent" and that product which as intermediate product or finished product displays one or more assemblies effected in accordance with the invention.

With the invention it has been found that the described binding material shall not necessarily consist solely of aluminium oxide, in that it has been found that there can be other material candidates such as zirconium oxide as a full or partial replacement for aluminium oxide. For the time being, it must merely stand as a condition that use is made of a suitable "binding agent material", which in lightly sintered form can be infiltrated by glass or a corresponding ceramic material. Other candidates for the binding agent will

be various commercial ceramic materials, namely metal oxides, which can well be available as mixing materials.

As mentioned, with the invention the use of the known "firing table" can be omitted, but there is naturally nothing  
5 to prevent use being made of a formed firing table anyway. The demands can hereby be reduced regarding the initial binding, which shall be exercised by the discussed paste of the binding material, in that in this paste there can be mixed an active binding agent, e.g. gelatine or water-soluble adhesive,  
10 sive, which will provisionally ensure the necessary binding together, but which with certainty will be burned away in the subsequent sintering process. It applies in general that the demands regarding the said initial binding will be reduced by use of the "firing table".

15 Certain of the relevant sinterable materials will give lower breaking strengths than with the best materials, but super-high breaking strengths can well give rise to problems with regard to the removal of hitherto bridge parts, and for this reason it will often be acceptable to use weaker materials.  
20 als.

It will thus be understood that the method and the binding agent according to the invention will not be bound up with quite certain materials, but rather with the characteristics of these materials, and hereby that the invention will  
25 also apply with the possible appearance of new materials with relevant characteristics.

## C L A I M S

1. Method for the preparation of dental bridges of sintered material fired with porcelain, by which on the basis of an impression of a relevant implant area there is formed a physical or virtual bridge item in a three-part formation comprising two bridge anchors and a connecting intermediate link (pontic), which parts are reproduced in a tightly-sintered oxide or related material and thereafter bound together with a binding agent for the formation of a bridge frame on which a hard ceramic coating is fired, c h a r a c t e r i s e d in that as a binding agent use is made of a suspension of basic material for formation of said tightly-sintered material, namely aluminium oxide or a material related herewith, which can be sintered and infiltrated with glass, and in that the hereby assembled bridge frame is heated for direct sintering of the applied binding agent, after which the thus stabilised bridge item, at least in the assembly areas, is given an application of a dispersion of a powder of an infiltration material of glass or a corresponding material which, with renewed heating in the bridge frame, is brought to melting and infiltration in the sinter-fired binding agent.

2. Method according to claim 1, c h a r a c t e r i s e d in that as binding agent use is made of a moulding mass based on one or more metal oxides such as aluminium or zirconium oxide or materials related herewith or mixtures hereof.

3. Method according to claim 1, whereby the binding agent is mixed with one or more additional binding components such as gelatine or dissolved adhesive which are dispersed by the heating in the subsequent sintering process.

4. Method according to claim 1, whereby the bound-together bridge frame parts are transferred for heating of



the binding agent in the sintering process without any additional mutual support.

5. Dental bridge frame item executed as a glued-together three-part formation of two bridge anchors and a  
5 connecting intermediate link (pontic) with respective adjoining connection surfaces, between which there is embedded a binding agent, c h a r a c t e r i s e d in that said binding agent consists of a moulding mass in the form of a dispersion of aluminium oxide or a material related herewith,  
10 which can be directly sintered or is already loosely-sintered by a first heating and can be infiltrated with glass or is already infiltrated by a subsequent heating to higher temperature under influence of an outer dispersion of "glass powder" or a corresponding infiltration material.

15 6. Binding agent for use in the assembly of ceramic dental bridge parts, c h a r a c t e r i s e d in that it consists of a dispersion of aluminium oxide or a corresponding material, e.g. zirconium oxide, which can be sintered by heating in the formation of a slightly porous structure which  
20 can be infiltrated by melted glass or a corresponding material.

7. Binding agent according to claim 6, c h a r a c t e r i s e d in that it is mixed with an adhesive material, e.g. gelatine or a soluble adhesive, which is degassed by the  
25 heat in the sintering process.

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/DK 01/00197

## A. CLASSIFICATION OF SUBJECT MATTER

IPC7: A61C 13/00, A61K 6/06

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: A61C, A61K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 9913795 A1 (SANDVIK AB), 25 March 1999 (25.03.99)  --	1-7
X	US 4772436 A (TYSZBLAT), 20 Sept 1988 (20.09.88)  -- -----	1-7



Further documents are listed in the continuation of Box C.



See patent family annex.

## \* Special categories of cited documents

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

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"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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"&amp;" document member of the same patent family

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# INTERNATIONAL SEARCH REPORT

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